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Article

Leveraging a Community of Practice to Build Faculty Resilience and Support Innovations in Teaching during a Time of Crisis

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Abstract: Amidst the COVID-19 upheaval to higher education, a grantor-led community of practice (CoP) supported faculty members to deliver an innovative, sustainability-oriented entrepreneurship curriculum and maintain resiliency as teaching professionals. This paper discusses how through engagement in the CoP, this group of faculty from across engineering, material science, business, and geosciences demonstrated resilience, adaptability, and pivoted to create curriculum for students in real time, as the events of the COVID-19 pandemic unfolded throughout 2020 and impacted face-to-face learning. The role the community of practice played in sustaining and supporting the faculty will be discussed. Case studies from faculty members will demonstrate how sustainable design and social responsibility can be integrated into entrepreneurially focused classes and student experiences across disciplines. The primary contribution of this research is the important role that an emergent learning framework can play in informing how best to optimize the CoP format and approach in a way that leverages and addresses individual member strengths, challenges, and experiences, and supports the needs of CoP members during a time of significant change and crisis.

Keywords: faculty community of practice; resilience; COVID-19; sustainability-oriented entrepreneurship education; teaching cases

1. Introduction

While dissemination of best practices at conferences and through papers remains one of the leading approaches to fostering the adoption of innovative teaching practices, there is limited evidence that such practices do little more than raise awareness of said innovations [1]. This is true even when innovative teaching practices have been proven to be effective [2]. Rogers [3] posits that this hesitancy in adoption is due to a sense of uncertainty about the innovation, and this uncertainty can be overcome by connecting with others that have adopted said innovation. In a campus context, the adoption of innovative teaching practices can thus be positively impacted by peers, whether it be colleagues on campus that have adopted similar approaches [4] or members of a community of practice (CoP), which can include colleagues from other institutions [5].

When VentureWell—a not-for-profit organization with a mission to cultivate a pipeline of inventors, innovators, and entrepreneurs driven to solve the world's biggest challenges—set out to promote the integration of sustainable design on university campuses, these challenges to adoption were considered. An approach was therefore designed that com-

bined faculty grant seed funds with an experiential in-person workshop and a one-year long CoP.

In addition to the anticipated complexities of incorporating new and experimental sustainable design strategies into coursework, the faculty CoP also experienced the unanticipated challenges of delivering coursework in a global pandemic approximately halfway through the first year. This disruption led to rapidly evolving curriculum changes, shifting delivery modalities, content modifications, and topical changes to reflect a shifting social, economic, and ecological context. The stressors of teaching in a global pandemic demanded a different type of engagement than was initially intended for this CoP, as its participants navigated this call to greater resilience, creativity, and pedagogical innovation in their course delivery.

This paper examines the way the CoP, designed by VentureWell, helped foster the integration of sustainable design and provided the faculty with the support needed to persist and innovate in the face of a global pandemic. We employed multiple methods, including an analysis of an emergent learning approach and autobiographical case studies, to examine the ways in which engagement in a CoP supported the implementation of sustainable-design educational innovations.

1.1. Communities of Practice in a Higher Education Context

Teacher collaboration and communities of practice within professional development of teachers is found broadly within research literature [6–13] and take various forms [10] (p. 69) as “co-teaching, mentoring, reflecting on lessons, group discussions of student work, a book club, a teacher network, or a study group.” These methods are applicable to faculty professional development and can be used to improve student experiences in a post-secondary setting. Using collaborative learning in professional development of faculty is supported by social constructivism precepts and the work of Vygotsky [14] that learning is a deeply social process with extended Piagetian framings of an individual’s cognitive processes by introduction of the zone of proximal development, where learning is a shared and social experience. The social nature of learning is not reserved for young learners; teachers as learners can similarly benefit from access to others [15]. Engaging activities and active learning occur when faculty are involved in their learning, rather than passively sitting through lectures or demonstrations [10]. Additionally, faculty benefit from introduction to concepts of life-long learning, an essential aspect in producing self-directed high-quality faculty for program sustainability [16]. These practices can be built through communities of practice who meet on a regular basis [17] to develop and implement engaging instruction for students.

By participating in communities of practice, faculty benefit from connecting with and feeling supported by individuals who “share a concern or passion for something they do” [17] (p. 1). The value experienced includes the exchange of innovative practices, and how best to contextualize those practices, such that these practices can be adopted and adapted on a variety of campuses [18]. As described by Schreurs et al., the face of faculty development is shifting from formal learning models to a mix of formal and informal learning models, with CoPs contributing to that informal learning aspect [19]. Benefits of participating in a CoP as a form of faculty development include, “a sense of community, self-awareness, motivation and validation of current practices and beliefs” [20] (p. 1).

As noted in the previous section and other research, the value of CoPs is well-documented in times of ‘business as usual’ [21]. However, there is a growing consensus that CoPs can be effective structures for developing resilience in practitioners in a number of fields, including medicine [22,23], disaster management [24,25], and particularly amongst educators [26]. Most universities abruptly transitioned to online learning in the spring of 2020 as a result of the COVID-19 pandemic and CoPs have been highlighted as an effective strategy to support faculty amidst COVID-19-related disruptions [27–31].

In highly dynamic situations and in times of crisis, decisive, rapid, and agile actions of faculty are needed to ensure the continuity of the educational experience [32]. For many

faculty, the disruption caused by COVID-19 included a transition to online learning in just a matter of days [33,34]. In 'normal' times, faculty generally resist the transition to online learning and are told to "plan ahead" as a means to minimize disruption to the learning experience [35]. However, in these circumstances, the majority of faculty were forced to modify at least one aspect of their courses during the transition to remote instruction, including modalities of delivery of content, class communications, and strategies for assessment [34]. A large study of 897 faculty and administrators and at 672 U.S. institutions also discussed other modifications described as "emergency teaching and learning approaches", which included making changes to course expectations, assignments, and exams [34] (p. 6). Given these sudden changes, "faculty and administrators identified a need for assistance related to student support, greater access to online digital materials, and guidance for working from home" [34] (p. 6).

In the time since the disruptions caused by COVID-19, the stamina and resilience of university faculty have been repeatedly tested by ever-changing demands of the teaching environment, the breakdown in student mental health [36,37], and the larger social, political, and economic uncertainties at a global scale [38]. "Experiences during the early months of the pandemic were described [by faculty] as being overwhelming and exhausting, and participants described as being stuck in a cycle of never-ending repetitiveness, sadness and loss, or managing life, teaching, and other professional responsibilities with little sense of direction" [39] (p. 1306). This raises questions about the factors that contribute to resilience at the individual level and in society, more broadly. "Resilience definitions address issues of being prepared for unexpected events, recovering after them, picking up early warning and weak signals, learning from past events, addressing conflicts and information sharing between actors, working on institutional weaknesses, educating managers and leveraging social networks, all while serving citizens whose routines, emotional and physical stability and livelihoods are interrupted in minor and major ways. Resilience as an adaptive quality of the people . . ." [40] (p. 118). At the individual level, resilience is improved by sufficient social support [41] and at scale, social capital leads to greater community resilience [42]. Teo et al. [43] (p. 136) define organizational resilience "as the process of developing relational networks that allow the organization to adapt and restore function". These definitions and circumstances related to resilience provide a useful lens through which to view the role of the VentureWell CoP in supporting faculty grantees throughout the COVID-related disruptions.

1.2. Design and Evolution of the Sustainability Curriculum Community of Practice

VentureWell (VW) aims to support faculty and students in developing innovations to make positive social and environmental impacts. To that end, VentureWell provides grants to faculty ("Faculty Grants program") to support the development of educational innovations. In spring 2019, VentureWell piloted the explicit inclusion of sustainable design into the request for proposals (RFP). The RFP sought applications from faculty seeking to develop new courses or programs, or strengthen existing courses or programs that focus on the incorporation of principles and frameworks of sustainability, with the end goal of novel sustainable designs and/or sustainable technologies. Following an external review process, eight faculty grantee teams were selected from the applicant pool from institutions from across the country and across disciplines including design, engineering, and geology (Figure 1).

As a part of the application process, grantees agreed to set aside time and grant funds to participate in a two-day Green Launchpad Educators Workshop and follow-on monthly CoP meetings. The workshop and the CoP meetings were integrated into the grant cycle in an effort to maximize the adoption of sustainable design teaching practices. The overall framing for the design of the workshop and CoPs was guided by Wenger's definition of CoPs as being, "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" [17] (p. 1).

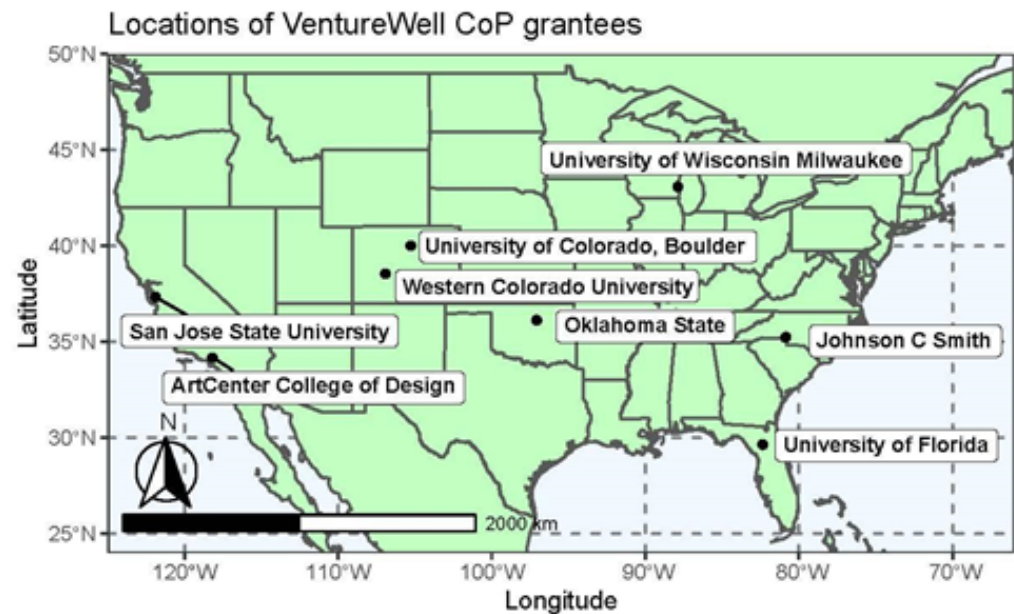


Figure 1. Locations of VentureWell CoP grantees.

The two-day in-person workshop was centered around key sustainability concepts, tools, and methodologies participants might adopt in their classroom. Participants shared their plans for integrating sustainability at the outset, shared helpful resources midway, and provided project updates at the close of the workshop that integrated concepts learned during the workshop. Additionally, plentiful unprogrammed breaks were integrated to provide participants with an opportunity to connect personally. The workshop approach was designed to enable participants to experience the value of connecting with peers working on a shared area of concern or interest, as well as the value of engaging with workshop content, and the project plans and resources they shared with each other.

Before the close of the workshop, two CoPs were formed comprising participants from four different institutions, with one to two team members from each institution. The specific participant makeup of each CoP was based on preferences expressed by participants at the end of day 1 regarding which individuals and teams they felt they would most benefit from working with. Monthly CoP meetings were hosted and facilitated via Zoom by the two facilitators. Facilitators were also responsible for scheduling the meetings, assembling the agenda, distributing meeting notes, and capturing key learnings about the CoP.

As suggested by previous literature, the monthly meetings were used by the facilitators to explore the value of the CoP from the immediate social-emotional support of faculty participants to the long-term realized value of systems-wide integration of sustainability curriculum into university programming [44]. The facilitators were also able to use emergent learning practices to adapt the framework of the CoP in response to the shifting educational landscape during the COVID-19 pandemic.

2. Theory and Methods: Understanding, Evolving, and Assessing the Value of the CoP

Communities of practice (CoP) are referenced with some regularity in faculty development literature [45,46]. However, when looking across different implementations, approaches range from large-scale online listservs to top-down knowledge management efforts, to homegrown small group convenings. One can argue that such variations are necessary, given the distinct goals and contexts of each CoP. However, the variations can leave CoP practitioners uncertain about how best to design and continue to evolve a CoP. An emergent learning framework was therefore adopted to consistently monitor and optimize the efficacy of the CoP. The role of the CoP was to support individual faculty in the shared goal of implementing sustainable design into their curricula and creating lasting system-level changes in university programming. A value creation framework

was additionally used to evaluate how the CoP provided value to faculty engaged in redesigning and instructing courses that integrate sustainable design.

The research contained two phases: (1) Individual interviews with faculty grantees and (2) Autobiographical case studies from faculty grantees. Participants were chosen based on their receipt of faculty grants from VentureWell's grants program and their participation in the community of practice throughout the year of the grant cycle. All participants were invited to participate in the two-part study. All participated in the first interview phase and only a subset participated in the second case study phase.

2.1. Emergent Learning Framework

Emergent learning is an iterative framework where independently operating individuals develop and test strategies toward accomplishing a shared goal and through dialogue and interaction, they realize solutions to seemingly insurmountable challenges [47]. An emergent learning approach was utilized for facilitators to explore the question: "What will it take for faculty to learn from each other through a CoP-and for them to apply that learning to foster systems-level change at their university?"

An emergent learning table (a four-quadrant process tool that supports a team to come together around a specific question and share their stories (data) and their interpretation of these data) was developed by the two VentureWell meeting facilitators (Figure 2) and the VentureWell program evaluator. Learning logs (a document where the VentureWell team tracks their assumptions, learning, and insights around the framing question as the hypotheses are tested) were used to reflect on and track patterns in monthly CoP meetings. In an initial meeting, the learning log was populated with learnings grounded in the facilitators' past experiences with CoPs, and sub-hypotheses were developed to test as part of the emergent learning strategy. Data including the structure, format, and content of each CoP meeting was collected via tracking notes. Iterative analysis of these tracking notes was conducted on a quarterly basis using a collective learning log and discussions. Facilitators met with a VentureWell program evaluator on a regular cadence, providing time to reflect upon their observations. This process enabled the facilitators to optimize the CoP meetings in real time, providing for both a flexible and resilient approach to supporting the CoP participants and their work. Findings were documented in the learning log to track the ways in which strategy yielded hypothesized outcomes.

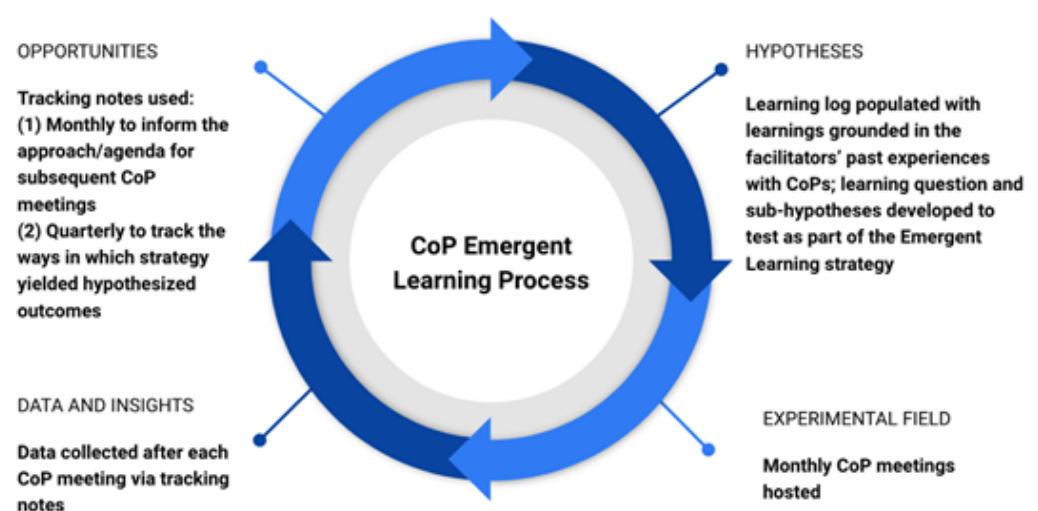


Figure 2. The emergent learning process employed for the VentureWell community of practice.

2.2. Value Creation Framework

Wenger-Trayner's cycles of value creation framework captures how value may evolve over time as a part of a CoP [48]. Leveraging this framework, the current study explored if engagement in a CoP added value to the faculty practice of developing a sustainable

design course or program. The research sought to explore: the individual level gains faculty received from their participation in the CoP; if and how they applied their learnings to changes within their course, program, or institution; and what enabling or orienting factors supported the functioning of the CoP. Additionally, the study explored to what extent faculty processes aligned with the Wenger-Trayner's cycles of value creation framework.

Faculty members who met the criteria of currently working at the institution that was funded as part of the faculty grants program ($n = 8$) were contacted to participate in a short interview to understand if and how CoP members applied learnings from the CoP into their curricular change efforts and what that change looked like. Among the eight possible participants, seven ($n = 7$) members completed a 20-min interview with S. Lipkin-Moore, a program analyst at VentureWell. The semi-structured interview protocol was grounded in the following exploratory questions:

1. To what extent did faculty report changes in their knowledge, motivation, and sense of connection through their participation in the CoP?
2. In what ways did faculty apply their learnings from the CoP to modify their course or program?
3. In what ways did faculty apply their learnings from the CoP to catalyze institutional level changes?
4. In what ways do faculty experiences align with the Wenger-Trayner cycles of value framework?

Interviews were recorded on Zoom between December 2020 and January 2021. Interviews were transcribed by a transcription service and checked by S. Lipkin-Moore. Transcripts were imported in a qualitative data analysis software package, Dedoose, for coding. A start list of codes was generated based on an evaluative codebook developed for the faculty grants program, guided by a program level theory of change, as well as codes generated on an initial review of the CoP learning logs and interview transcripts. An initial cycle of coding was conducted on two interviews using this coding framework, where additional codes were generated, and a finalized codebook was developed. Using the final coding scheme, S. Lipkin-Moore reviewed the data and assigned codes to each unit (e.g., words, sentences) within Dedoose. Prevalent unique codes and co-occurring codes were identified, and were grouped into themes, following the methodological procedures established by Braun and Clarke [48]. Trustworthiness of the analysis [49] was assessed in multiple ways: (a) responses between participants were cross-checked (*triangulation*), (b) interviewees collaborated on the reporting of the analysis (*member checks*), and (c) staff members reviewed the interpretation of the data to ensure accuracy (*peer review*). The themes generated were validated through the analysis of the learning logs and subsequent case studies. Lastly, we used an exploratory autobiographical case study approach [50] to explore the ways in which individual faculty member experience aligned with the theory underlying the value creation framework [44]. Five case studies were used to illustrate how engagement in CoP supported curricular change.

3. Results

Overall, the results suggest—through engagement with the CoP—all faculty engaged in a process of learning that resulted in impacts at the student or course level. Across all interviews, the pathway through which (at least one) meaningful change occurred was: (1) building strong relationships, (2) sharing stories of successes and challenges in course development, (3) shifting individual ways of thinking or approaching a course or program, and (4) adapting and applying learning or knowledge to their course or program. As illustrated below, unique interpersonal and structural supportive factors enabled faculty member resilience through participation in the CoP through the difficult early months of the COVID-19 pandemic.

The following sections explain: How the meetings of the CoP were structured (Section 3.1); the experiences of the participants as analyzed through a third-party interview process (Section 3.2); and the experiences of the participants through auto-

biographical case studies (Section 3.3). Each of these sections contributes to a more complete picture of the CoP and the experiences of the participants and its facilitators.

3.1. Emergent Learning: CoP Optimization and Adaptation to Support Faculty during the COVID-19 Pandemic

For the first six monthly meetings of the CoP, 15 min were allocated to each institution to provide a brief project update along with a request to the group for assistance with a challenge associated with project implementation. This design was informed by a desire to create both a sense of forward momentum and accountability, as well as to firmly situate the CoP conversations in the practice of each participant.

After six meetings, the two smaller CoPs were merged. Facilitators had observed this shift to a single group might be useful due to the overlapping topics of conversation across the groups, and the desire expressed by participants to hear the perspectives of colleagues from other disciplines. However, the need for this shift was galvanized by the emergence of COVID-19 and the shared challenge experienced by participants of adapting their teaching, in real time, to modalities that continued to shift between blended, in person, and online. Participants were eager to learn how to adapt to these challenges with a broader group of colleagues with different campus contexts and disciplinary areas of expertise. Given the increased workload and sense of uncertainty faculty experienced due to COVID-19, pre-work was limited for participants by eliminating reports on project implementations. Social-emotional support was instead emphasized by including time for participants to share and empathize on current stressors and challenges. Participants also co-created the agenda by adding their own desired topics or engaged in a process of nominating and upvoting topics such that a meeting could have a single topical focus. This approach continued for the remainder of the two-year grant period, because it provided participants with social-emotional support needed, and the flexibility to co-create an agenda that helped address the immediate COVID-related challenges at hand, i.e., adapting teaching practices to different and fluctuating classroom modalities, including online, hybrid learning, and learning in classrooms, with the added complexity of mask wearing and social distancing.

3.2. Analysis of Value Creation through a CoP

Data in this section was collected by a program analyst from Venturewell who was not directly involved in the CoP throughout. The participants were asked to recount their experience for the purposes of program evaluation and improvement. Their interview responses were then compiled into this synopsis by the program analyst.

3.2.1. Shared Purpose and Connection as a Precursor to Meaningful Sharing (Immediate Value)

Across all interviews, relationships with other members were named as central to the success of the group's CoP. Several interviewees described that the opportunity to meet face to face (during an intensive 2-day *Green Launchpad* training) provided an opportunity for members to develop personal connections, build trust, and develop a shared purpose:

"The Green Launchpad was an amazing launchpad to kick it off, and the fact that we met in person, I think it's what sustained the Community of Practice, it's much harder to do it when you've never met in person."

Another faculty member reported:

"I think that is intrinsic to the nature of a Community of Practices that you have this sense of shared purpose. And so, because there's a sense of shared purpose, you have a sense that you're there to help your peers also achieve that sense of purpose."

The personal connection and "sense of solidarity" among the group, enabled a deep and more authentic level of sharing:

Faculty: In terms of emotional support, it's [the CoP] been great. In terms of real details, everyone's really open, just shares everything. And so, that's been fantastic.

Interviewer: So, there's that level of comfort . . . ?

Faculty: Oh yeah. They're really generous, would just give away anything that they had made Like a syllabus, an idea. And then, there's been great connections . . . [Now] I have these ideas and now I have some actual resources behind them.

The group had a shared understanding of what they were working toward and developed the personal connections necessary for the group members to have trust and be vulnerable with their work.

3.2.2. Variability in Individual Strengths, Challenges, and Experiences to Enhance Group Resilience (Potential Value)

Four interviewees named that the variability of members' backgrounds, expertise, and experiences made it such that each member could provide and learn about new and different ideas. Importantly, learning from others about what's worked and what's not worked in their specific contexts enabled faculty members to apply those learnings to their own context. For example, one faculty member described how they thought about student group work (and the need for scaffolding within the group):

I didn't know, probably everything I should have known to help prepare E-Teams and especially the younger students, right? So how do I plan that into not only my curriculum, but [also] provide the external supports that those students need, right?

The Community of Practice is really nice because you realize that different participants that you're working with have different strengths and weaknesses. And there's always great ideas that you can steal from other people. So I think they're really good for that because even if it's just one part of it, there's different clever pieces that people have that make it really useful.

Moreover, because the CoP outcomes were emergent, it allowed for members to be responsive to the most immediate needs, which enabled faculty to lend support where others experienced challenges:

For me the greatest benefit is . . . I don't know what I don't know. And if I'm just talking to people on my campus, that gets to be a bit of an echo chamber. So it's nice when I'm talking to people spread across the US to get an idea of what they're doing and the tools that they're using and resources they have. The people that they contact on their campus when they have questions or issues. And it's those kinds of things where I wouldn't know the questions to ask, but just being part of that conversation. I'm like, "Oh, there's a little golden nugget that fell out. I can do that here or maybe I cannot do that here but modify that for something else.

The variability in disciplines, stages of the work, strengths, and weaknesses emerged as an important aspect of what made the group "work":

The student examples have been helpful to me . . . [because] I never knew what a student project could really look like, or should look like, what level is appropriate . . . all of the faculty who are involved really do have different expertise themselves . . . and they have all different experiences and how they've built student teams, the kind of projects they worked on, the way they've structured their courses So just hearing all these different strategies to motivate students, help them emotionally work through this, in their teams to build successful teams with different personality types. To make everyone feel really welcome in the team. It's just been really helpful to just see everyone's accumulated experience and distill that into like, okay, what do I think is going to work for us?

Consistent with these experiences, knowledge sharing between CoP members is reflected in the presence of key information shared between members, captured in the learning logs. Synthesis of the learning log suggests that all CoP meetings included sharing between members, and involved "advice", "sharing materials and tools", and "ideas" in four areas: (1) navigating campus policies, (2) expanding the container (e.g., activities outside of the classroom, drawing in other faculty, connecting with other courses), (3) content (lesson plans, videos, readings), and course design (pedagogy, flipped classroom).

3.2.3. Consistent Structure and Cadence Foster Accountability and Sustained Momentum (Applied and Realized Value)

Relationships were integral to fostering a space whereby faculty felt comfortable to share. However, an essential element that moved faculty members from sharing stories to applying their learnings relates to the consistency, expectations, and structure (facilitation) of the CoP meetings themselves. The CoP met once a month, and enabled faculty to get into a rhythm needed to progress in their practice:

“The community of practice is amazing, because suddenly, there is accountability and pacing.”

Other faculty members explained:

I think the other thing too was making people [CoP members] think about it [the topics] in advance . . . then also the expectation that you’re going to show up to help other people. It was very clear that we were going to first talk about what we needed and then everyone else was going to help us with what we needed and there was an opportunity and almost a responsibility for everyone to be able to do that on every call with varying levels of depth, depending on what we all had to contribute. I think that was a big part of it.

It’s a little bit of . . . implicit peer pressure . . . [you’re] . . . always thinking like oh okay, I might not do much this month because I’m busy with other things, but on the other hand, I want to be able to share something with the group, so it’s like, might as well do something and not push it for next month. So that’s in a sense, accountability and because the meetings were regular, that creates the pacing because it’s predictable . . .

Moreover, two interviewees named the importance of the group facilitators in creating and supporting a structure that allows for continuity. As one interviewee said:

I will tell you that sustained interaction is extremely important And I think it’s probably more meaningful than even participants understand because it provides the accountability measure, it provides the sort of guide on the side . . . [And] you have two great facilitators that have a lot of really good ideas, [and] are super enthusiastic.

The results indicate that the structure and cadence of monthly meetings was important to achieving meaningful change. This was largely because faculty were able to share and discuss challenges in real time, and were able to learn from each other’s experiences as they tested new approaches. Further, the implicit pressure and accountability encouraged members to engage in their work in between meetings, which enabled faculty to have more content and experiences to share with the CoP.

As such, across interviewees, the most common realized value faculty described was a course-related impact. Faculty identified specific strategies, approaches, and tools that they learned from other members of the CoP that strengthened their course. As one faculty member described, the group supported each other in testing ways to enhance collaboration among their students in a virtual environment:

Interviewer: You’ve mentioned having ways to collaborate was one of the things you learned in the community of practice. [Did you mean] having ways to collaborate in a virtual platform?

Faculty: YeahWe’ve been learning in our community of practice about various tools you can use for [collaboration] . . . We brainstorm with students in person and they just put post-it notes on a whiteboard and made notes. And so we’ve learned some ways to translate that into the online environment.

Further, four faculty added the ways in which the addition of sustainability-focused class projects impacted students. Faculty were also able to share with the CoP COVID-19-related adaptations for engaging students’ design, fabrication, and team work across multiple modalities. Specifically, faculty noted that students gained from solving for real problems:

“So the students really liked it and I think there were a couple of factors that went into that. One, I really pushed them to figure it out. They felt like they were doing

something towards a real world solution and knowing that we had the incubator, they were competing for the incubator. They all really hustled to try to get there. So I think that was a big part of it."

Ultimately, the appreciation for the group and perspectives was summarized in a learning log entry from one of the concluding meetings of the group: *"most of the conversation [in the meeting] focused on next steps for the group and gratefulness for the CoP and all that they gained from it in terms of learning and connections. [They] also talked about taking the facilitation techniques [of the CoP] and approaches into other contexts."* Beyond the content received from the group, the structure and facilitation of the CoP was an additional learning faculty could apply to their own work.

3.3. Case Studies

This section contains a series of reflective autobiographical case studies written by the participants in the CoP to more specifically address how their personal resilience was enabled through their experiences with the CoP as they implemented their grant activities and courses amidst the first round of COVID-19 disruptions.

3.3.1. Case Study: Western Colorado University

The VentureWell GreenLaunchpad grant supported the development of a new course entitled "Waste = Food: Science-Driven Innovation for Rural Circular Economies" at Western Colorado University in Gunnison, CO in the fall of 2020. The intent of the class was for student teams to develop new product concepts from locally available waste materials that could be upcycled to create novel forms of value using circular sourcing and supply chain strategies. Throughout the semester, the teams developed their product concepts using various circular economy tools and compiling their ideas using the Business Model Canvas [51]. The course was cross-listed to attract students from environment and sustainability, business, biology, and honors departments to create an interdisciplinary team experience for one semester at the ICELab, Gunnison County's economic development center (pictured in Figure 3).

The majority of course planning occurred in the application process for the grant submission, so much of the conceptual work was completed early on in the course development cycle. However, the unknown modalities of delivery and the uncertainty of the semester schedule for much of the summer of 2020 before the course made planning tenuous, at best. Additionally, the ICELab's plans to deliver their Incubator program were also uncertain with COVID-19-related disruptions. Ultimately, the in-class content remained similar to the original plans and the class was able to take field trips to the local landfill and recycling center. Unfortunately, an overnight trip to companies working in the circular economy was not possible and the class instead took a local overnight camping trip for an immersive biomimicry workshop. Additionally, the intended live pitch event was replaced with team video submissions to an online voting platform and distributed to the campus community and their personal social networks for a competitive voting process. The successful team recently completed the incubator program, developing their concept to make messenger bags and wallets from discarded whitewater raft material.

One valuable cultural component of the course experience was the establishment of class values, which served as a periodic touchpoint to align the students and provide a framework for shared values in a time of great social and cultural uncertainty. This concept came from the sharing of teaching resources with other members of the CoP and the class values that this other faculty member provided served as an example. Class values were:

- Repeated failure evolves our thinking and progresses our ideas.
- Creativity, ingenuity, and innovativeness are learned skills, not inborn gifts.
- Do not expect anyone to know the answer to your questions.
- Be solutions-oriented but ensure that you fully understand the problem first.
- Maintain integrity despite uncertainty.
- Be ready to adapt, pivot, and become more resilient.

- Trust each other and our intentions.
- Let play and curiosity guide our actions.



Figure 3. Students prototyping circular design concepts in a makeshift outdoor classroom.

The course has since developed into two other programmatic activities related to innovation in the circular economy. The first will be a student design competition in partnership with the new School of Engineering on the Western Colorado University campus to be delivered in the 2021–2022 academic year. The second evolution of the grant is a proposed new interdisciplinary master’s degree in circular design and manufacturing, a first of its kind program.

Overall, the development of this course had a powerful impact on the students, faculty, and affiliated organizations to experiment with circular economy mechanisms in a rural mountain community. For the faculty and students involved, it demonstrated the enriching experiences that can emerge in unpredictable and co-creative learning settings. It also enabled the faculty member to demonstrate how these concepts can be effectively used to advance economic development, potentially providing opportunities for the larger community, and prototyping how the university can support student entrepreneurs in sustainability ventures. Finally, it set the stage for the implementation of a longer-term design competition and master’s-level degree program, which will attract new kinds of students to Western from diverse fields of design, engineering, and business for sustainability.

3.3.2. Case Study: University of Florida

The course EMA3000L Sophomore Materials Laboratory at the University of Florida, Herbert Wertheim College of Engineering, Department of Materials Science and Engineering was designed to address gaps students had for application of materials knowledge to real world problems and to help these students have a hands-on experience early in their academic pathway. Funding from Venturewell Green Launchpad allowed the class to explore biomaterials design and application for additive manufacturing and resources

from the Venturewell “Green Toolkit” (<https://venturewell.org/inventing-green-toolkits/>, accessed on 11 June 2019) were used to support the class in design thinking.

Having a CoP as part of the support from Venturewell allowed for the sharing of practices and ideas across disciplines and helped to bring in diverse voices and practices, including from arts and design courses, geology courses, sustainability courses, and business courses. Having instructors from varying disciplines all applying sustainable practices led to a rich sharing of ideas, and proved particularly useful when COVID shut down face-to-face classes and remote learning environments dominated the landscape. Through the CoP, best practices for remote learning were shared and refined, including those for student groupings, breakout room activities, remote design teams, prototyping, and pitch presentations. Having CoP meetings allowed for a constant iteration of the class and provided support for what directions seemed to be supporting student engagement more than other pathways.

These practices became important in spring 2020, and were applied strategically to the design of the spring 2021 remote laboratory course, including development of specific team building experiences early in the semester to promote remote teamwork practices and development of strong frameworks and rubrics for use throughout the course. The Venturewell Green Toolkit also supported remote learning and student work on the early design pieces and LCA analysis for the design process.

Students were able to work remotely in groups to create a business canvas for their work redesigning more sustainable light sources (flashlights, headlamps), and the remote nature of the design work led to more group accountability for students to assure that project deliverables were met. Student teams utilized agile principles for the design process, which allowed for more resilience in the teams for design changes and remote communication issues.

3.3.3. Case Study: San José State University

The VentureWell grant supported further development of a new team-taught Earth system science course at San José State University in San Jose, CA, USA. Earth system science instructors and students have a unique appreciation of the long reach of time and the interconnected nature of the Earth’s spheres: hydrosphere, geosphere, biosphere, and atmosphere [52]. With the knowledge of the processes and the rates by which Earth has changed in the past, geoscientists realize human impacts on all Earth spheres are likely unprecedented and demand immediate intervention [53–55], but students enrolled in traditional geoscience programs receive little training on approaches to sustainability. Support from the CoP allowed SJSU instructors to initially develop and implement a sustainability-focused class project and to reconfigure the project to adapt to the online learning environment. Following experiences in the CoP during the fall 2019 Green Launchpad meeting, the final project for the ongoing Earth system science course was immediately reconstructed to focus on a sustainable product redesign. Students developed a systems map of a product they were interested in re-developing for sustainability (Figure 4A), conducted an abbreviated life-cycle analysis, and decided on business model goals in order to complete an evaluation of their sustainable project solutions. In spring 2021 when the class was taught a second time, the course was reframed to center the sustainability product redesign by frontloading concepts and goals for global sustainability and by including more in-class work time and intermediate project deadlines. This new project scaffolding emerged through a year of personal reflections and conversations with the CoP. The CoP was also a crucial source of tools and resources for evaluating sustainability, including systems mapping, life cycle analysis, and design thinking principles as an iterative approach toward sustainable product redesign. The 2021 course was adapted for a completely online remote experience. Online resources and exercises developed by VentureWell provided springboards for lesson plans and student projects. Conversations with the CoP helped to troubleshoot solutions for design projects taught remotely.



Figure 4. (A) Students in the fall 2019 course working on a systems map. The physical space does not always support equal participation of all group members; (B) A systems map constructed remotely and iteratively throughout the semester allowing for simultaneous participation by all team members.

Discussions throughout the year with the CoP supported building effective student teams including surveys on personal assets and goals for growth, methods for managing teams through team contracts and the RACI model [56] and tools for collaboration (Mural) and creative thinking including six thinking hats and the creative problem solving process [57]. Online collaborative documents including Mural, Google Drive, and Canvas discussion boards proved to be more amenable to teamwork than analog counterparts (post-its, whiteboards, notebooks) by allowing students to revisit and iterate on ideas, collaborate remotely on their own schedules, and democratized participation, whereby there was “space” and “tools” for everyone at the drawing board (Figure 4A,B).

Conversations with the CoP also provided invaluable suggestions for how to support our geoscience students through the unfamiliar process of sustainable product redesign by connecting to engineering faculty, the on-campus sustainability board, and the broader SJSU entrepreneurial ecosystem, which includes an innovation club and annual business and design competition. In the 2021 course, a self-reflection survey was assigned to students to allow the instructors to build resilient student teams that balanced personality, working style, and topic interest [1,58–60]. The CoP continues to inspire the instructors to incorporate more creativity-driven exercises and to provide more design experiences using on-campus maker spaces at the reestablishment of face-to-face instruction. Students did reflect on a continuing commitment to sustainable living and a new quantitative appreciation for the broad scale of systemic changes needed for Earth system sustainability.

A considerable broadening of perspectives has been an overarching outcome of faculty participation in the VentureWell CoP. Finding solutions to problems arising from unsustainable ways of living demands not only scientific understanding of the Earth system, but consideration of the socio-economic factors that drive individual and collective decision-making and actions. The geosciences are inherently interdisciplinary, but Earth scientists do not traditionally engage in investigation of complexly interacting planetary and human systems. Engagement with the CoP has introduced new colleagues, conferences, programs,

and literature that interweave scientific concepts with ideas and practices drawn from other disciplines, including sustainable design and social responsibility. This more holistic view of the Earth system not only shaped the development of a new Earth system science course, but also helped to catalyze a new undergraduate degree in Earth system science and helped to guide the selection of appropriate electives from beyond the College of Science to include courses from engineering, business, and environmental studies.

3.3.4. Case Study: University of Wisconsin-Milwaukee

In this project at the University of Wisconsin-Milwaukee (UWM), the multidisciplinary teams of faculty were set to investigate two questions: (1) “how might we design a Community of Practice for 200+ UWM instructors teaching sustainability-related classes” and (2) “what would happen if we started experimenting with the learning experience ‘containers’, i.e., courses, workshops, etc.?”

To explore the first question of designing a faculty CoP, the UWM team proposed to facilitate a series of faculty workshops around a theme of “Hacking for Sustainability”. The “hook” for the faculty was: how might we help the students who are passionate about sustainability topics to form collaborative teams across disciplines and to channel their passions into project-based explorations? The first two-hour workshop (12 June 2019) focused on empathy, i.e., understanding the aspirations and needs of a diverse group of instructors across colleges and disciplines around topics of sustainability. Through peer conversations and inferences, a group of 25 participants offered a first look at the opportunity space in the form of generative questions that looked like this:

- “How might we help Portia, professor of film, to disseminate knowledge and sustain research projects?”
- “How might we help Michael, freshwater sciences, to encourage his collaborators to take the risk to embrace new big ideas?”
- “How might we help Bob, urban planning, to engage and empower community members to advocate for their own safety in their neighborhoods?”

Grouping questions together revealed a few themes outlining faculty/instructor needs and aspirations that emerged from the workshop (in the form of *needs*):

- To identify collaborators/establish and maintain relationships.
- To create a network/connect disciplines/establish collaborative environment.
- To drum up interest/disseminate knowledge/reach more students.
- To transform industry/engage community members.
- To find time/secure funding.

In parallel, the UWM team started investigating the second question: what shape, i.e., “a container”, might the new teaching and learning experiences take for the faculty and students? Instead of designing an entire new course (there are 400+ courses on sustainability topics in the UWM course catalog), the initial plan was to develop a not-for-credit summer workshop, “Hacking for Sustainability”, designed and delivered by a group of self-selected faculty across disciplines. Faculty would invite their students who would form small teams, start ideas exploration, get connected to the UWM entrepreneurial ecosystem, and develop through various launch pads (VentureWell E-Teams, NSF I-Corps Site, UWM Startup Challenge, etc.). Unfortunately, this concept was not possible with pandemic-related disruptions.

Fortunately, with the help of this CoP, the UWM team pivoted towards rapid low-resolution experimenting in the form of an in-class mini hackathon around these six topics of food scarcity and insecurity. The team picked an existing multidisciplinary course, *ME-405: Product Realization*, and the hackathon partners that had vested interest in this topic area—UWM Office of Sustainability and the Milwaukee RiverWest Food Pantry. The team tested three key hypotheses:

Hypothesis 1 (H1). *Students will be able to self-organize and form rapid teams around six topics tied to the hackathon theme based on their internal motivations and passions.*

Hypothesis 2 (H2). *Students will be able to explore the problem space on-line with the help of area experts and identify a problem to work on and hack for solutions in 2.5 h.*

Hypothesis 3 (H3). *We can assemble a teaching team for this experiment, instead of a solo instructor.*

The experiment was conducted in the fall 2020 using a 100% online teaching and learning environment. Instructors used two virtual collaboration environments for the hackathon: Zoom and Mural. Prior to the hackathon, students had experienced two design sprints and were exposed to design thinking methods and mindsets. The hackathon included three blocks (see Figure 5): (1) a 60-min problem exploration that included interviewing experts and doing some background research on the problem; (2) an 80-min design sprint (hacking) around the problem statement; and (3) a 20-min showcase of their low-resolution virtual prototypes. Here is what we learned.

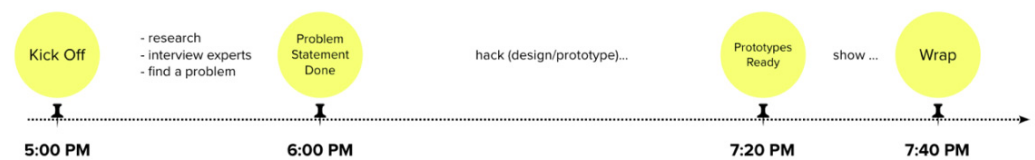


Figure 5. Timeline of the Hackathon event.

Students were able to identify the topic area of their interest and self-organize into six teams. They then conducted interviews (example in Figure 6) around shopper experience in the neighborhood food pantry.

During the hackathon, instructors intentionally blurred the lines between ideation and prototyping (those are usually separated as distinct steps of the design process for novice learners) and encouraged hacking. Figure 7 provides an example of the solution idea prototyped graphically in Mural addressing a problem of promoting food pantry in the community beyond just food.

The teaching team hypothesis was validated and we were able to assemble a team of experts for interviews from the food pantry and the office of sustainability. The class had already been taught by a team of two instructors and the results suggest that this method could be used to meaningfully connect instructors from various courses.

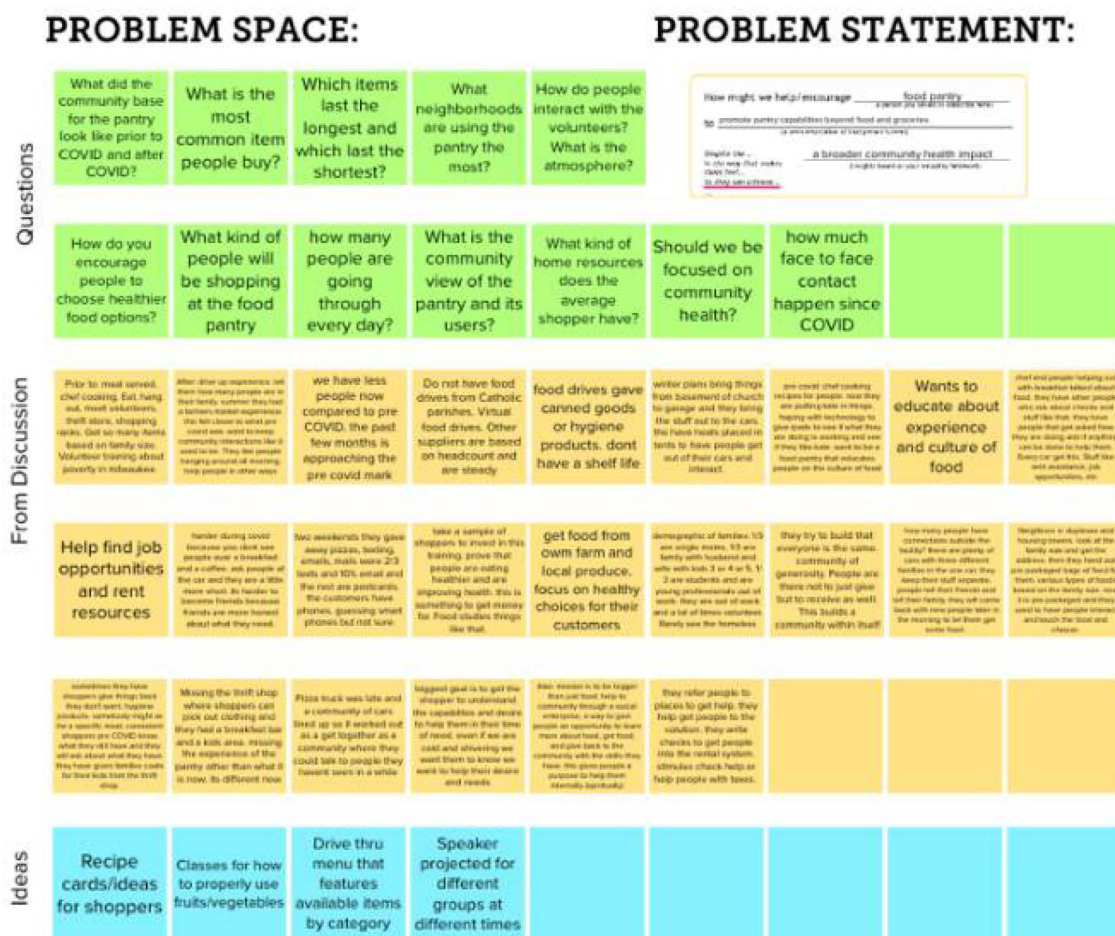


Figure 6. Hackathon process outcomes.

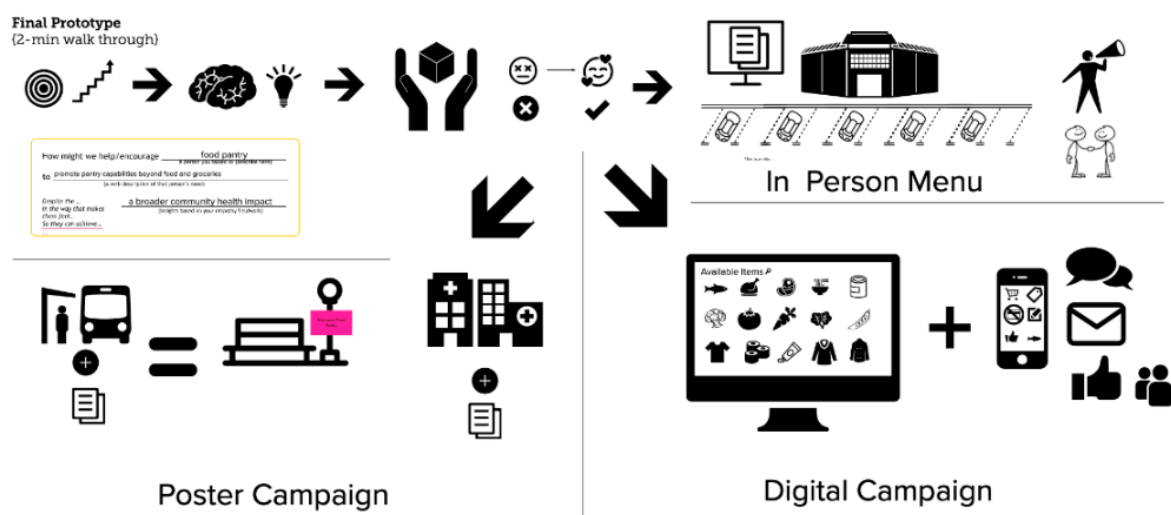


Figure 7. Sample prototype from Hackathon.

4. Discussion

At the outset, the CoP was designed to support a group of faculty grantees as they worked to integrate sustainable design and entrepreneurship into the curriculum. The CoP supported this effort, and due to the emergent learning approach, was also able to flexibly adapt to meet the exigent needs of the group. The CoP thus effectively supported

faculty through the disruptions related to the COVID-19 pandemic. Achievements in teaching and mentoring—despite the pandemic—include faculty establishing, revising, and implementing student support systems inspired by the CoP, including explicit class values, highly scaffolded team construction, and frequent student feedback and subsequent course adjustments. Achievements in classroom innovation include multiple student-centered design projects and class competitions that incorporate “real-world” scenarios including food bank accessibility, upcycling outdoor recreation gear, and responding to natural hazards. Accomplishments in university-wide program development includes the initiation of an interdisciplinary University of Wisconsin-Milwaukee sustainability CoP, partnerships between the School of Business and School of Engineering as well as a new MS degree in circular design and manufacturing at Western Colorado University, and a new BS in Earth systems science at San José State University.

The faculty interview quotes and case studies, while diverse, support existing literature which suggests “engaging with a multidisciplinary community of practice can . . . provide more than online educational skills; they foster a sense of togetherness and a safe environment to share concerns and challenges on both a professional and personal level” [29]. The immediate value experienced, including personal connections, trust, and shared sense of purpose, developed throughout the CoP paved the way for faculty to generously share their promising practices (potential value) and co-mentor each other in a way that enabled the resilient adoption and adaptation of promising practices on their own campus, in the face of unpredictable social and economic disruption of the COVID-19 pandemic (applied value and realized value). We contend that a CoP, organized around a shared concern, that leverages an emergent learning framework can allow (1) CoP facilitators to adapt the CoP format and approach to meet evolving needs, which in turn (2) enables CoP participants to equip themselves with the social-emotional support and social learning needed to be resilient in the face of disruption (Figure 8).

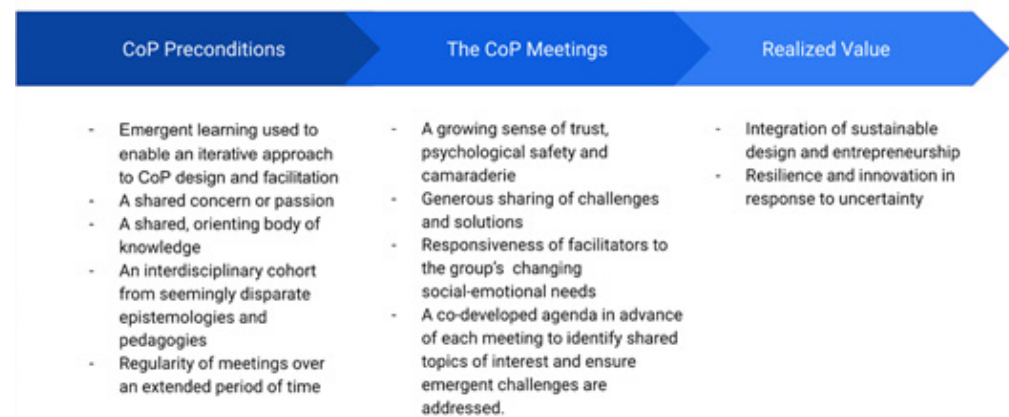


Figure 8. Summary of what this study has identified as the effective CoP preconditions, e.g., approaches to CoP design, group configuration, features of the CoP meetings including how meetings were run by facilitators and experienced by participants, and ultimately the realized value experienced by participants.

According to Teo et al. [43] (p. 136), “Resilience may be framed as the capacity to bounce back to a state of normality, or as an emergent property, when an organization learns to adjust to adversity and in the process, strengthens its capability to overcome future challenges.” One barrier often cited with regard to the introduction of curricular innovations is competing priorities and time [1]. The added disruption of the COVID-19 pandemic produced an interference phenomenon for VentureWell CoP participants, wherein innovative class delivery formats, new structures for student support, teambuilding, project scaffolding, and novel scholarly programs emerged as a result, as suggested is necessary in previous studies, e.g., [32]. Together the faculty and facilitators of the CoP, while learning to adjust to the complexities associated with the COVID-19 pandemic, overhauled their

courses, and made vast improvements to the student experience. Given that resilience has been described as “an adaptive quality of the people” [40] (p. 118), it is clear that the CoP contributed to the ability of the participants to adapt to the rapidly changing conditions of the work environment, social engagement, and tools of learning and teaching. These faculty and their courses will not be reverting to “normal” in future semesters but instead have used the disruption to build better courses that integrate new skills and approaches, and are addressing the needs of their local environment and community stakeholders. New interdisciplinary frameworks established throughout the duration of the CoP provide infrastructure support for continued innovation and future integration of sustainability into university systems. Establishing and facilitating faculty-centered CoPs are an effective approach to support faculty when navigating disruption and may have the added benefit of catalyzing organizational transformation. As the interviews and case studies exemplify, the resilience of the individuals involved was enhanced by the social support of the group, in alignment with existing literature (i.e., [41]).

The types of transitional states the CoP participants experienced have also been described as periods of liminality in other research related to organizational resilience (e.g., [43]). Liminality is a period when routines are disrupted, and new relational connections are “made to allow members to adjust psychologically, emotionally, and socially, to activate resilience. Within the liminal period, leaders influence(d) the formation of new connections through mutual and swift trust and utilize(d) these networks to enable collective meaning-making and sensemaking. If resilience is a necessary component and hoped for outcome of group dynamics, it is critical that educators, leaders, and facilitators become attuned to emerging moments of liminality, and integrate that awareness into the process of group facilitation. In times of crisis, it is necessary for leaders to recognize that a moment of liminality is emerging and to “communicate mindfully via these networks to promote positive emotional connections among members” [43] (p. 136). The CoP and its facilitators clearly supported the period of liminality of the 2020–2021 academic year.

Figure 8 below captures the characteristics and features and outcomes of the supportive approach used.

5. Conclusions

This analysis adds to the growing body of literature that suggests that CoPs can help professionals, particularly educators, to adopt innovative teaching practices, even in times of significant uncertainty. The autobiographical quotes and cases provide detailed examples of how resilience was demonstrated by a cohort of eight grantees participating in a VentureWell CoP. While each case was unique, they all demonstrate how the addition of this more informal social learning modality for faculty development [19] had the added benefit of fostering support, camaraderie, and open sharing of challenges and ideas around the practice of teaching and learning, which in turn enables faculty to successfully pivot and execute on their grant-funded projects, despite regular and consistent disruptions. One might argue that the CoP not only fostered resilience, but it also ensured faculty benefited from the challenges of the pandemic by supporting them to experiment with their teaching approach and build interdisciplinary connections, in much the same way that participatory managers support their employees to take risks as they seek out new innovative approaches [61]. Indeed, several CoP participants maintained that the teaching and learning innovations that resulted would endure beyond the life of the pandemic. Additionally, the student experience may have benefited overall from the uncertainty and subsequent need to pivot, since students engaged in new ways of thinking and working, and were able to observe the agile way in which their faculty adjusted their approach in real time in response to a constantly changing landscape.

This study highlights the important role that the emergent learning framework plays in ensuring the CoP itself is poised to flex and demonstrate resilience to changing circumstances in much the same way the faculty members are supported to be adaptive and resilient amidst turbulent circumstances. The lessons learned from this study may support

faculty development practitioners in advocating for and integrating this more informal and social, and yet highly effective, approach to faculty development. It also provides a potential approach for other leaders and organizations seeking ways to productively support and sustain the work and creativity of others during times of change.

This analysis was limited by the number of faculty that were able to participate in the post-hoc analysis of the CoP through the writing and analysis process. Additionally, it only includes data from a single CoP and would benefit from a comparative analysis of various CoPs in higher education that operated during a similar time frame to develop a more holistic perspective of the impact on personal resilience in times of disruption.

Recommendations for further research include the integration of a comparison group of non-CoP participating faculty, to help better determine the degree to which participation in the CoP versus participation in informal networks of colleagues fostered resilience. Additionally, while this paper demonstrates the positive impact of a CoP on participants' ability to resiliently adopt and adapt innovative teaching practices during a time of significant change, it is also important to research and better understand the degree to which a shared period of liminality in turn impacts participants' sense of connectedness and willingness to share promising practices with other CoP participants. Given the important role that an emergent learning approach played in the responsive design of the CoP, a methods paper that captures that process and tools developed would also serve as an important and useful addition to the field. Finally, universities may consider professional development policies that explicitly reward participation in CoPs as they have been demonstrated as being overall beneficial for faculty members' overall resilience, life-long learning, and engagement in advance curriculum development.

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